AN EXPLORATION OF CHARACTER EMISSION RATES IN COMPOSITION

By

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Abstract of Dissertation Presented to the Graduate Council
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Major Department: Psychology

Six experiments explored character and word emission rates under controlled conditions with a variety of subjects. Day to day stability was seen in both character and word emission rates, but first session rates were not reliable indicators of general rate. Specific experimental tasks tended to control distinct rates. Both self-timing and release from tasks changed character rates, while self-timing was also seen with longer durations of writing. The control of character topography by consequences was also demonstrated, and a large effect was noted. Thus, both operant antecedent and consequent control of both response rate and topography was demonstrated for written composition.

Both hand written compositions and compositions written on a typewriter (computer keyboard) on various topics

and with various constraints were assessed. Suggestions for easier and cheaper measurements were made. Results were related to measurement problems in the teaching of essays, and suggestions for teacher measurement of composition activity in the classroom were made.

INTRODUCTION

If an experimental analysis of written composition is to proceed, a unit of response must be defined. Findley's (1962) work on multi-operant repertoires clearly showed the possibilities of a unit that itself was composed of smaller units of response. If language behavior in general and written composition in particular are analogous to Findley's multi-operant repertoires, we may be able to proceed with units defined at several levels. Basically, written materials are defined by combinations of curved and straight lines and dots. Gonzalez and Waller (1974) reported records generated by two subjects writing on an apparatus that responded to variations in pen pressure, and defined one class of responses by microswitch closures of .5 sec minimum duration between minimally specified IRTs. They found handwriting rates while writing were stable despite differences in schedule of reinforcement in effect but the schedule did control the pattern of pausing such that interval and ratio components of a mult FR FI LH are clearly distinguishable.

A larger response unit that has been considered is the word. Brigham, Graubard, and Stans (1972) reported

the results of several operations on mean word counts in a 5th grade "adjustment" class. In "Baseline" all students got points for sitting and writing during the writing period. Points were exchangeable for generally unspecified privileges and activities in the room. In the "Number of Words" condition, one point was given for each word in the stories written. In the next condition, "Different Words," two additional points were given for each initial use of a word in that story. Finally, in the "New Words" phase, the children were given an additional three points for each word that had never appeared in a previous story. An alphabetized list of all words used in earlier stories was provided for each child. Groups A (n=5) and B (n=3) experienced all conditions, while Group C (n=5) was exposed only to baseline and "Number of Words" conditions. The authors reported mean numbers of words written per group per session in each condition, mean numbers of "Different Words," and mean numbers of "New Words," as well as the mean times. In addition, the stories were rated on a 25-point scale and the ratings of each story were given. Inspection of the figures revealed a marked similarity in the shape of the functions for each measure within each group. The similarity of the time function to the others suggested that conversion of the counts to rates may reveal otherwise obscured relationships.

Figures 1 through 4 of Brigham et al. were converted to tables and the rates of words emitted per minute were calculated and charted (Figures 1 and 2, see data display section below for graphing conventions). Since Brigham et al. report sessions "twice a week" on the average, T Th lines were used for plotting. It was apparent that the major effect of the first contingency imposed (Number of Words) was to simply increase the time the children spent writing. Rates of word production were quite variable, and no consistent effect was obvious. The authors report rising quality point ratings during the experimental period, and suggest that it was possible that the rise in ratings associated with the "New Words" condition may have been the result of direct attempts to use new words, as

> . . . they worked harder and spent more time on the sentences, thereby producing more and better ideas while actually writing less. (p. 429)

More time was indicated on the graphs, but the word production rates did not drop, as this interpretation requires. Also, the mean ratings the stories received were charted as quality units per minute emitted by each group. Little change appeared in Group A's quality unit production rates throughout the experiment, except for a drop in sessions 9 and 10. Group B shows more variability, and also seems to share a small dip for those two sessions (among others). Group C shows the clear experimental effect of the "Number of Words" contingency—while the word

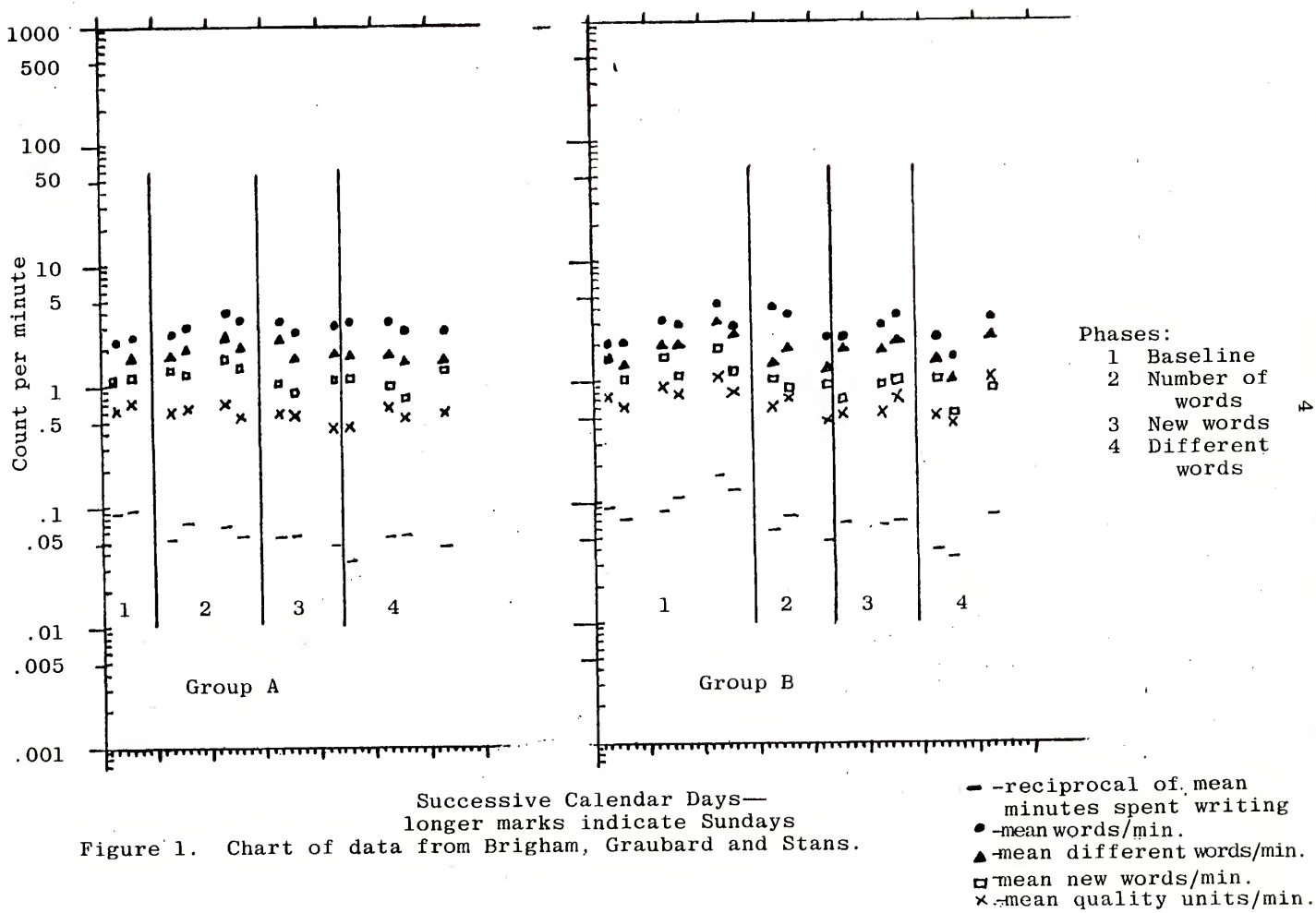
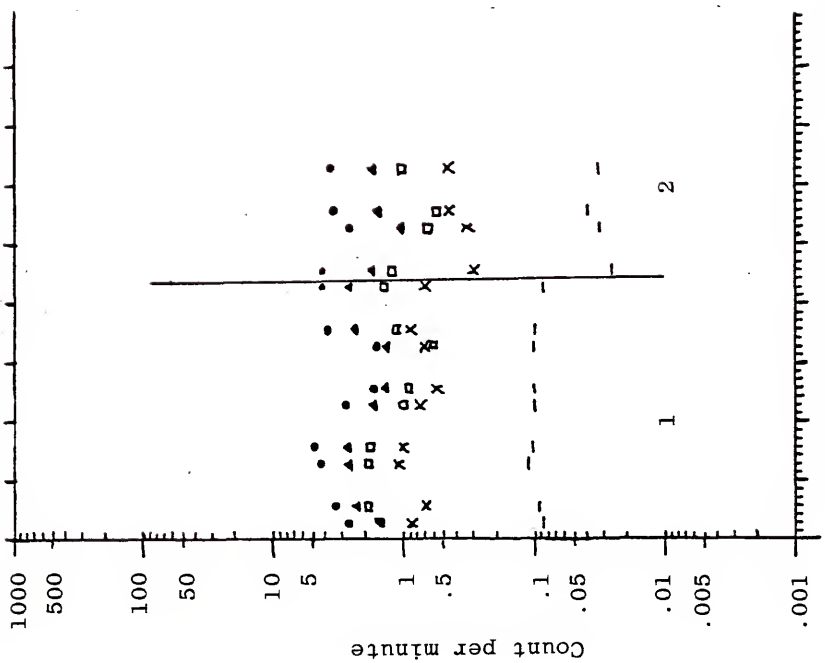


Figure 1. Chart of data from Brigham, Graubard and Stans.



Successive Calendar Days. Longer marks indicate Sundays.

Figure 2. Chart of data from Brigham, Graubard and Stans. Group C.

rates remain roughly stable, much more time was spent, and a very marked decrease in quality units per minute emitted is seen, denoting less efficiency. Plots of quality unit and word rates for the same sessions seem to suggest co-variation in trend, although the effect was not reliably seen. Difficulties in further interpretation lie in the problems inherent in converting graphed points to rate data and the report of group means rather than individual performances (Sidman, 1960).

In another study involving composition writing, Maloney and Hopkins (1973) reported the use of a permutation of the "Good Behavior Game" to change the number of different adjectives, action verbs, and sentence beginnings in 17 ten-sentence stories written by 14 fourth through sixth graders. They found no change in character or word emission rates throughout the study, but did report that selective reinforcement with extra recess and candy did change subjective ratings of the creativity of the stories. They did not report the rates of behavior.

Van Houten, Morrison, Jarvis, and McDonald (1974) reported rates of word emission for children in one second and two fifth grade classes. They discovered that explicit timing and feedback from the children counting their own words roughly doubled the response rate, from three to six words/min., in ten sessions. Stories were also rated on five dimensions, and the ratings were higher

during each of the timing and feedback phases. Feedback was provided by letting the children count their own words, which they did with 80-100% accuracy.

Of the three studies, only Van Houten et al. showed a rate increase, while all three reported "quality" increases during the experimental period.

While assessment of composition quality remains an important issue, measurement of composition rates is also needed. The studies cited above support the notion that counting the words emitted per minute by subjects writing essays may reveal interesting relationships between essay rates and environmental events. However, a gap existed in units of analysis at the level of the character between the behaviors recorded by Gonzalez and Waller and words counted by the others. The goals of the present work were, therefore, completely exploratory to measure some writing rates, to begin definition of a dependent measure of writing rates, and to examine relative sensitivity of rates of character and word emission. The research was not structured initially; rather as interesting phenomena came to light, new directions were taken.

EXPERIMENT I

To begin the investigation of compositional response rates, subjects were timed while they performed various writing tasks. One subject was seen in three preliminary sessions to establish timing procedures and experimental tasks.

Method

Subjects and Apparatus

Subjects S-802, S-803, S-506, and S-805 were female college students enrolled in Psy. 201 and serving for experimental credit. The first three were 18-year-old third quarter freshmen; S-805 was 19. Three subjects were black; S-506 was white. Session 1 for S-802 was timed with a Westclox (General Time) stopwatch; all other sessions were timed with a Running Time Meter (Cramer Controls). Experimental sessions were held in an office approximately 4 m x 5 m x 2.5 m containing two desks, files, chairs, and common office furnishings. Subjects were run individually, generally during normal school hours. Paper and a variety of ballpoint pens were provided by the E. Before

beginning, the purposes and methods of the experiment were explained to each subject and a standard informed consent form was signed by each subject.

Procedure

While sitting at the E's desk, subjects were given an experimental task number from the E's data sheet to write at the top of a fresh sheet of paper. They were then given specifications for the writing task to be performed. When ready, the timer was started and they wrote until told to stop. They then counted the words (or characters) written, the count was recorded, and rates calculated and displayed on six cycle semilog Standard Behavior Charts. The pattern was repeated until termination of the session. Subjects were asked to indicate any excessive hand fatigue. An informal and relaxed atmosphere was maintained, and all questions were answered fully. Words were counted by S-802 and during S-803's first two sessions. All subsequent counts were of characters.[1]

Experimental Tasks

Experimental tasks included copying a text which had been typed with six words per line on a duplication

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[1]Since tasks were standardized for Exp. 2, a more detailed description of procedure is presented in the method section of Exp. 2.

master. Triple spacing permitted subjects to write between the lines and thus keep eye shifts to a minimum. Subjects were also asked to write short essays on topics with which they felt some emotional involvement. A free association task (FA) was defined by instructing subjects to simply write whatever came to their mind. Limited association (LA) was simply all that they could think of to write relevant to a given topic. Other tasks included listing all of the possible uses for a specified common object ("Uses for . . ."), signing one's name, writing the alphabet, and writing a list of all the objects in the room. Subjects were also asked to generate lists of nouns, and were later asked to list adjectives or verbs appropriate to the nouns listed.

Data Display

Following a common practice in graphing dynamic phenomena in other natural sciences, semilogarithmic charts were used to keep and display frequency of response data. Two general types of charts were used: In the first, the count per minute of behavior was displayed on the line corresponding to the calendar day the data were collected. The second displayed the count per minute of behavior, but successive lines represent successive experimental tasks within one session. All data were labelled with true calendar days to permit unambiguous indication of the time relationships between various experimental

events. The log scale allows accurate predictions and both absolute and relative comparison of data from different subjects. The dots and x's indicate frequencies of behavior on the indicated day, and the dashes show the reciprocal of the time spent observing. Thus, the lower the dot, the lower the rate of behavior, while the lower the dash, the longer the time spent observing.

Reliability

Subjects were informed that spot checks were made of their counts. Limited resources did not permit all counts to be verified, but 50% of the experimental tasks were recounted. The accuracy of match between subjects' counts and reliability counts ranged from 88% to 100%, with 13% of the subjects' counts inaccurate. Letters, numbers, and punctuation marks were all counted as characters. Of the errors, 55% involved miscounts by two or less characters.

Results

Frequencies of words written per minute by S-802 are displayed as x's on Figure 3, while frequencies of characters written per minute (counted post hoc) are indicated by dots. Note the parallel relationship between the two frequencies in the copying task, in which the average word length was fixed by the original author. In the FA tasks,

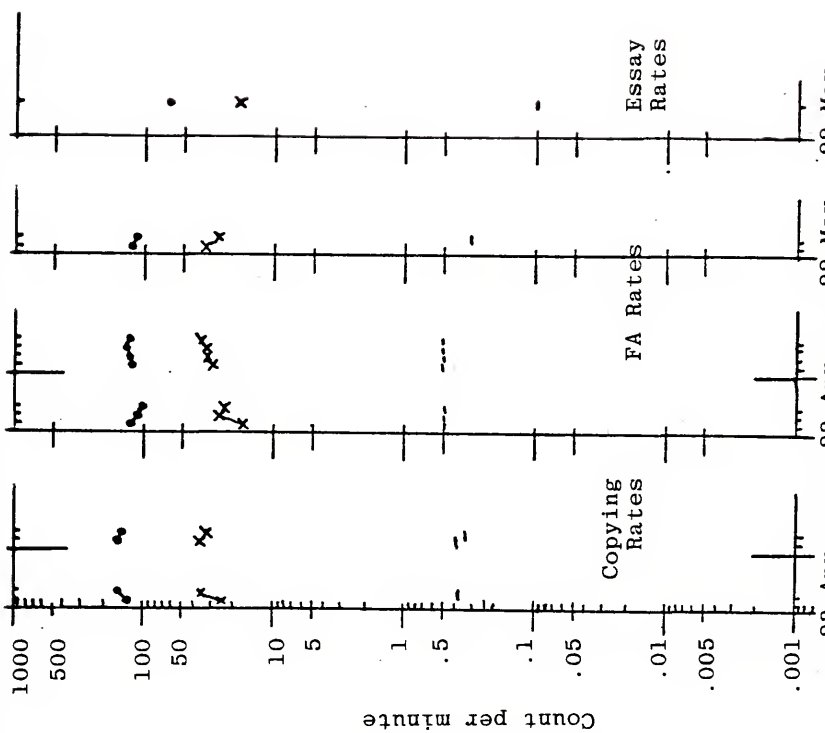


Figure 3. Chart of character (•) and word (×) emission rates for S-802 on indicated days.

some deviation from a fixed relationship was seen, partially due to a comparatively low word rate in the first FA task. Also, average word length changes from approximately 4 characters per word in the FA tasks to 3.5 for the essay.

Figure 4 shows frequencies of word and character production for S-803. During sessions on 5/21 and 5/22, only word counts were made. Note the steady rise in the FA and LA word frequencies for those days. Post hoc character counts indicated that the rise in word count was a result of shortening word length. (A similar effect may be seen in the 4/23 FA rates of S-802.) The effects of the subsequent shift to character frequencies over the next four sessions were to slightly raise the character frequencies while word frequencies gradually declined as word length increased. Frequencies of word and character production when the S was asked to list nouns were also shown, as were the frequencies of production when the S was asked to write adjectives and verbs appropriate to the nouns on the list. Note the much lower frequencies seen with verbs. Two lists were used, in the order ABA AB BA. Note that list B always controlled lower frequncies. List B was generated on 5/22, and list A was the second noun list generated on 6/5. The last two pairs of rates were generated under the instruction to simply produce lists of adjectives. The first performance of the "Uses for . . . common objects" tasks was not a good indicator of usual frequencies

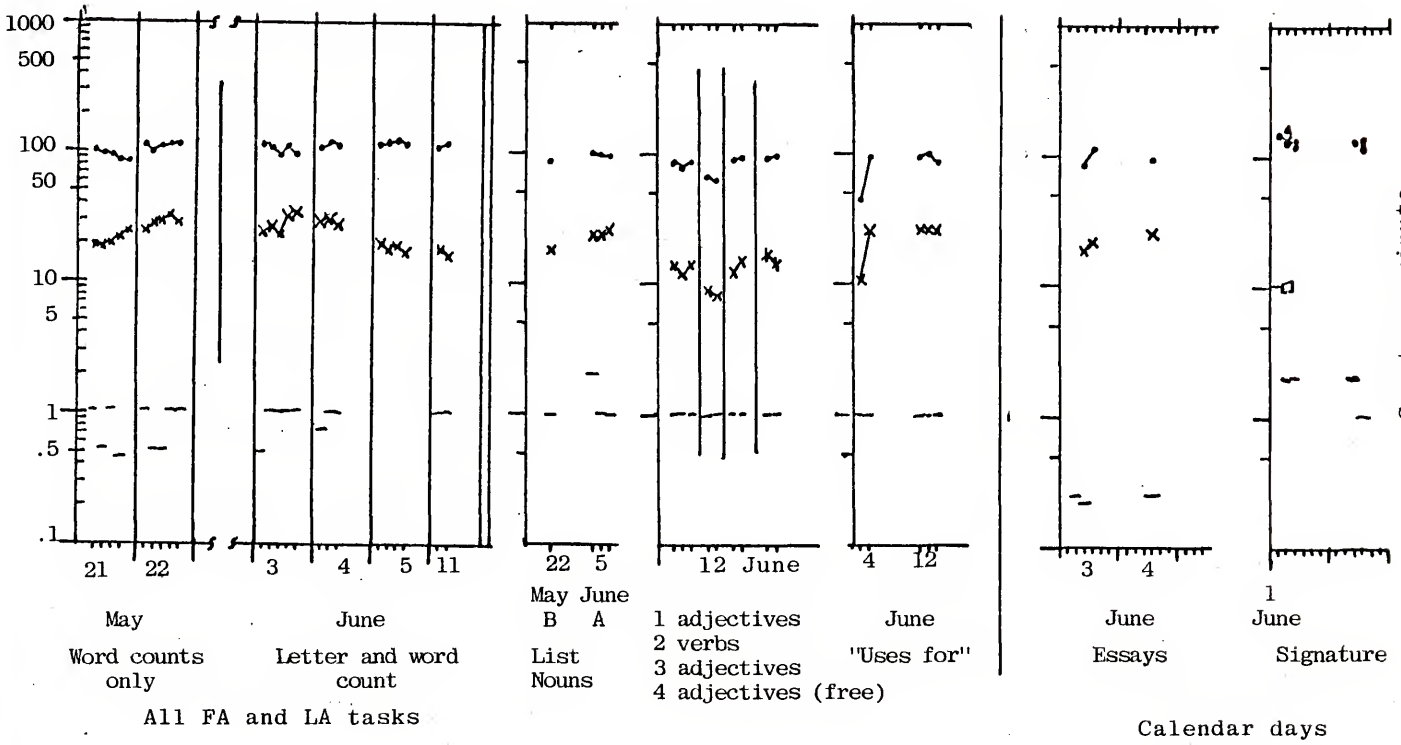


Figure 4. Chart of character (•) and word frequencies (×) on successive experimental tasks done on indicated days by S-803. Signature rates are plotted the calendar days emitted.

displayed by S-803. Also shown were her essay rates and her rate of character writing when signing her name.

Data from S-805 are shown in Figure 5. On two successive days, the same object was presented (a brick) in the "Uses for . . ." task. Note the jump in frequency of response. Essay and signature rates were unexceptional. Four tasks (list nouns, list adjectives appropriate to the nouns, list more nouns, and list verbs appropriate to the nouns) involving listing and relationships of nouns, verbs, and adjectives were presented on 6/8. Note the slower adjective rate—the first list of nouns generated contained all proper nouns. Also shown on Figure 5 were .5 min. and five 2 min. FA rates which were collected on 6/3. Each half minute during the longer samples was announced, and the S drew a line and continued writing, thus permitting sectioning of the sample into half-minute segments. Note the slight drop in frequency as the samples become longer.

Frequencies of character writing from S-506 were plotted on Figure 6. Her signature and alphabet writing rates seemed stable, as did her essay writing rates. Her description of the room tasks was segmented into quarter minutes, and the total overall rates as well as the first quarter and half minute rates were shown. The first sample rate was taken for .25 min., and was lower than comparable first quarter rates, although close to the overall rates

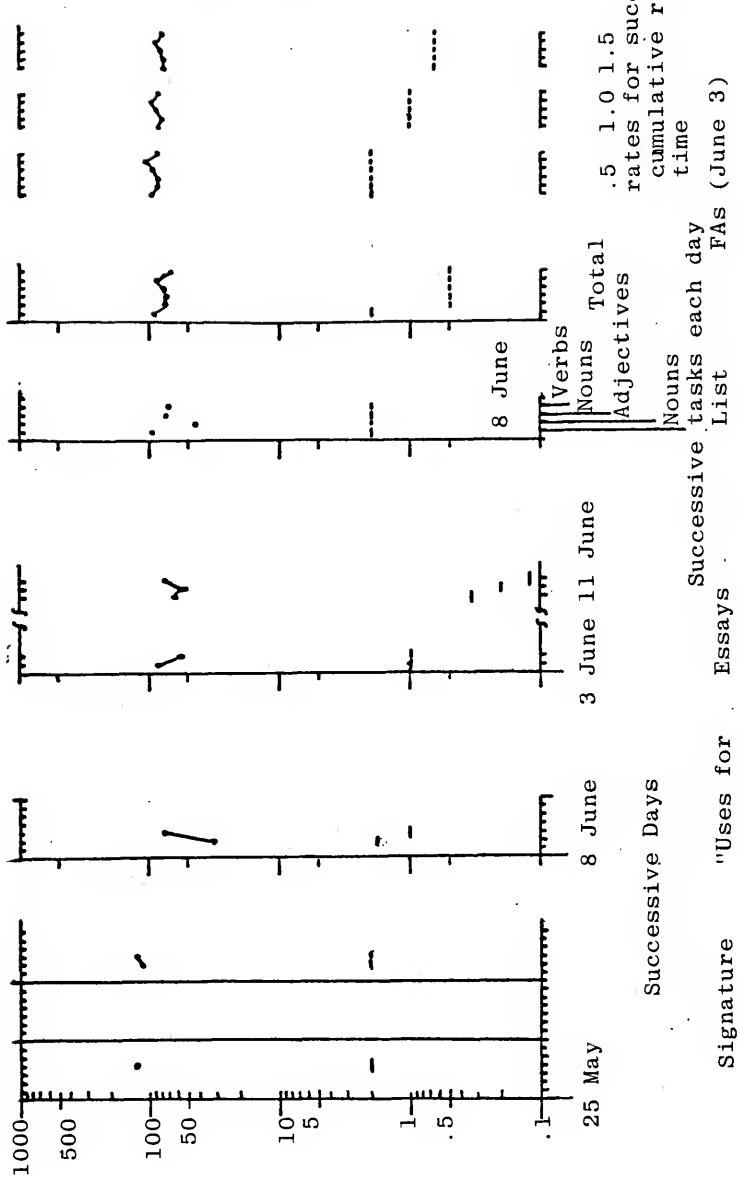


Figure 5. Chart of frequencies of character emission rates by S-805. Signature and "Uses for a brick" rates are plotted on the calendar days the tasks were performed. Longer lines indicate Sundays. Other tasks are plotted as successive performances on the days listed.

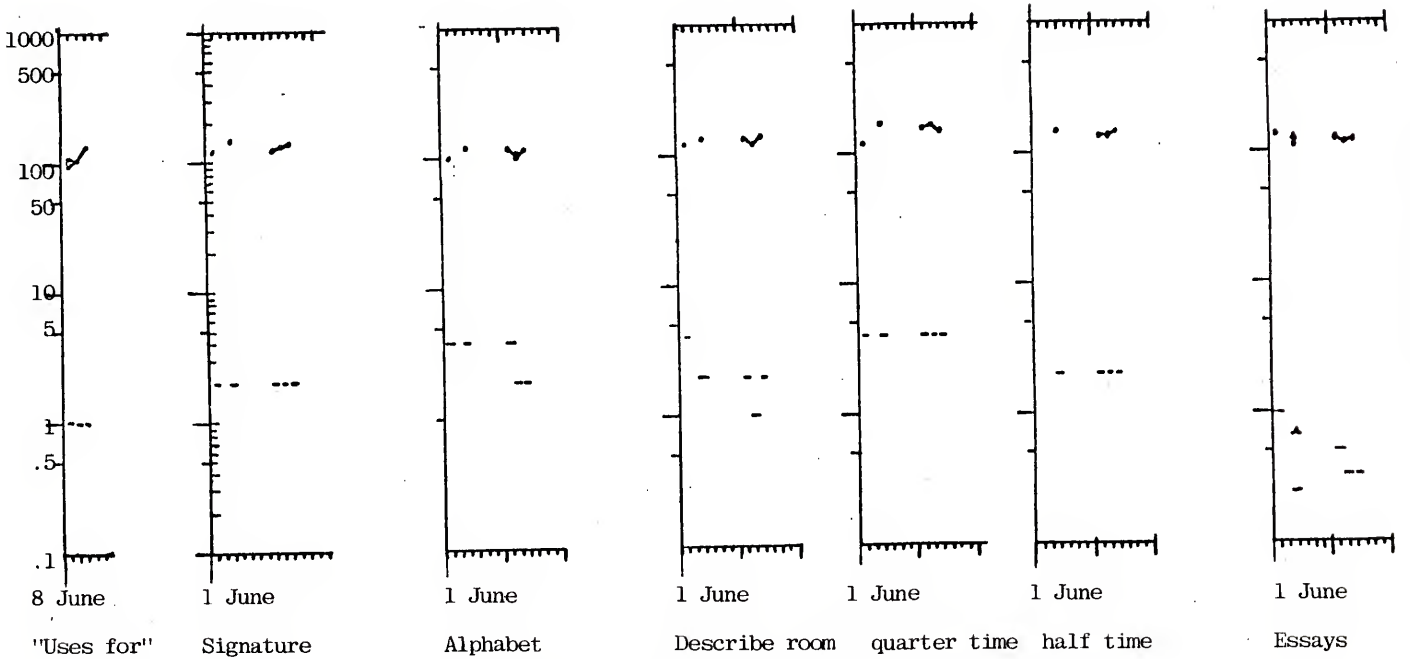


Figure 6. Chart of character rates on indicated tasks performed by S-506. Panels 5 and 6 show .25 and .5 minute recording times for the performances shown in Panel 4.

rates of the longer timings. The essay and "uses for . . ." rates were unexceptional.

Discussion

In general, character emission rates seem to be stable and predictable. Word rates seem less desirable as indicators, as S-802 and S-803 show a change in word rate without parallel movement in character rates. Further work involving fewer but more standardized tasks and shorter session lengths but more repeated measures was undertaken.

EXPERIMENT 2

Two subjects served to establish the daily stability of character emission rates, and one of those subjects demonstrated a change in rates. Procedures were designed to shorten experimental sessions and tasks were standardized.

Method

Subjects and Apparatus

Subject S-380 was a 38-year-old female college graduate. Subject S-922 was a 27-year-old female teacher with a master's degree. Both of these Ss consented to serve "to help the E find out about writing." Experimental sessions were held in the E's kitchen in the evenings after both Ss completed working days. A variety of ballpoint pens was again provided and unlined paper approximately 19 x 28 cm. was obtained by cutting used computer output paper in half with a bandsaw. Subjects wrote on the blank side. Timing was again done by manually operating the running time meter to signal the beginning and end of writing activities. The timer was checked against

the internal clock of the NERDC IBM 370/165 computer and found to be accurate.

Procedure

Since tasks were much more standardized in Exp. 2, procedures will be described in more detail.

A subject was seated at a table with pens and paper. Each task was numbered, and the S was asked to write her subject number and the task number (supplied by the E) on a sheet of paper. At a signal from the E the subject signed her name as many times as she could until the E signalled her to stop. She then counted all of the characters written and announced the count to the E, who recorded the details on her data sheet and plotted the performance on a standard behavior chart. The alphabet was next written under similar conditions, followed by either a short essay concerning a picture the E presented, or a task in which all the different possible uses for a common object named by the E were listed. The final task was typically a "free-association," in which the S wrote anything (comparable to Gonzalez and Waller's task).

Contingency

After 6 sessions, S-922 asked when she could quit, and at the next session she was told "we can drop any task on which you exceed a goal rate for 5 out of 6 days." At

her next session S-380 was also presented with this statement.

Stimuli

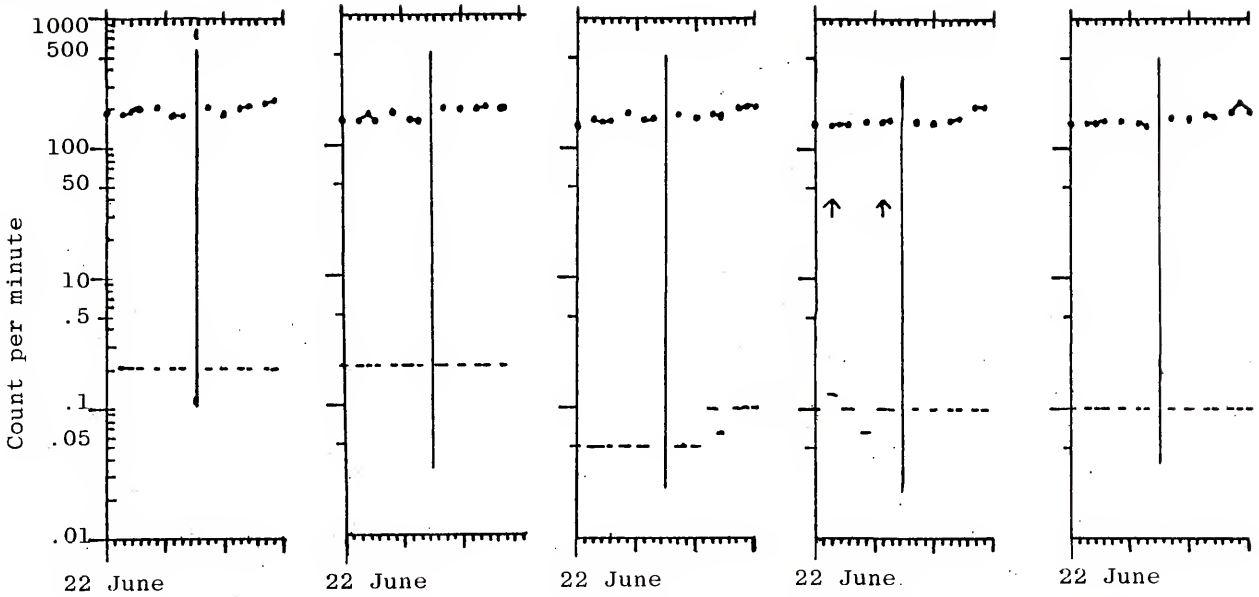
Pictures were provided to write about for the "Picture Essay" (PE) experimental task. Illustrations were cut from magazine advertisements or feature articles (typically color photos) and identifying text was cropped or obliterated. An effort was made to locate provocative pictures with an obvious point, such as those often seen in Psychology Today.

Another experimental task ("Uses for . . .") involved listing as many uses as possible for common objects named by the E. Objects included rubber bands, a pencil, paperclips, a brick, a bicycle, a safety pin, Scotch tape, a house, a car, a park, a barn, money, a rope, and a coin. Objects were named by the E in varying orders to each subject.

Daily charts and data sheets were kept on each S, and were shown whenever requested. Usually, subjects merely glanced at both.

Results

Figures 7 and 8 show the rate of character emission per minute by S-922 and S-380 respectively. The heavy dark line on the figures indicate the presentation of the statement



	Signature		Alphabet		Picture essay		Uses for . . .		FA	
Mean rate	186.3	211.3	158.6	187.6	168.5	193.6	152.1	178	155.8	186.8
Stability index	.119	.175	.063	.065	.20	.113	.071	.28	.082	.23

Figure 7. Chart of characters emission rates of S-922 before and after contingency arrangement (vertical line). †† indicate repeated presentation of the same stimuli. Performances are plotted in successive calendar days within each panel. Mean pre and post contingency rates are given with mean stability indexes. Stabilities were calculated by dividing the ranges of the last 5 persons by the median.

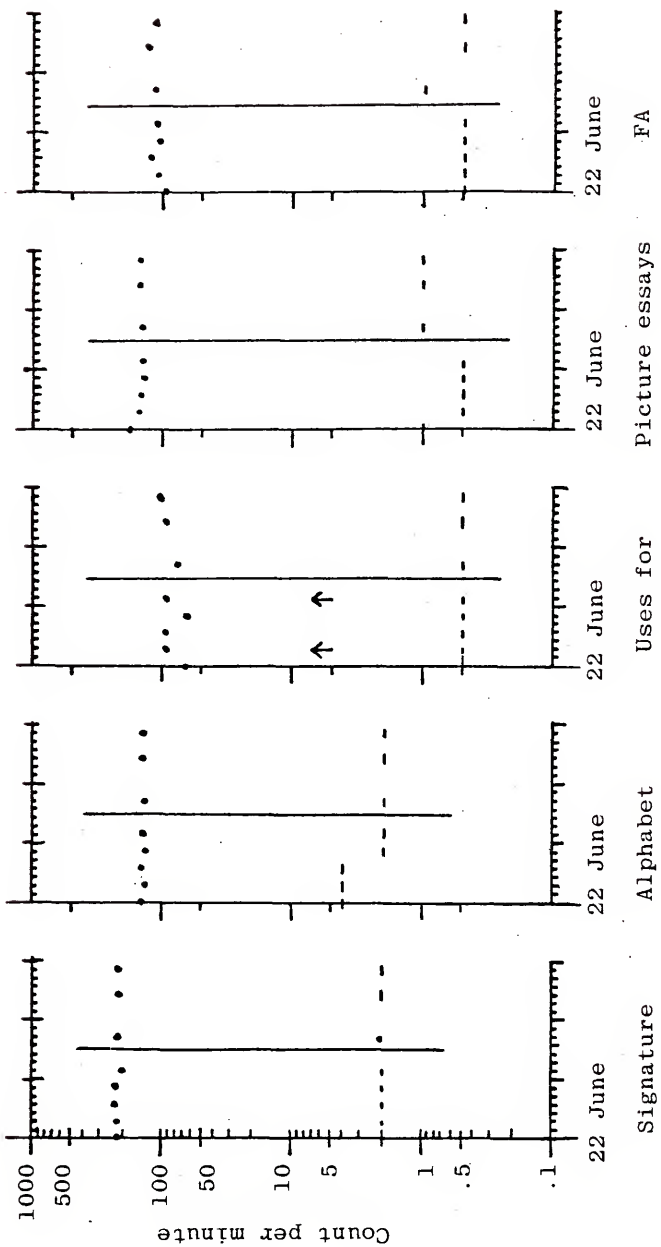


Figure 8. Chart of character emission rate for S-380 on indicated tasks. Successive calendar days plotted within each panel. ↑↑ indicate repeated presentation of same stimuli. Vertical lines indicate contingency announcement.

on quitting to the subjects. Note the immediate effect on S-922. She was writing her signature at an average rate of 183.6 characters per minute prior to the announcement, and after it her rate averaged 211.3 characters per minute. Similar increases may be seen in the other tasks. Note also the increase in variability after the contingency announcement. Daily and average pre- and post-announcement rates are given on Figure 7.

No such effect was noted for S-380. For this S, replication points were provided by presenting the same stimulus object in the "Uses for . . ." task on two different occasions, as indicated. Note also the "banding" exhibited by this subject. Each task controls a different set of rates of character emission.

Discussion

These two subjects provide evidence of the stability of the rate of character emission in daily experimental sessions. The effect of the contingency arrangement on S-922's rate indicated that perhaps the operant conditioning model would indeed be appropriate for written composition. In addition, S-922 started at a very high baseline rate, compared to the subjects seen in Experiment 1. The failure of the announcement to move S-380's rates simply suggest that it was inappropriate for her. In view of the weakness of

the E's nominal control over the total environments of both of these subjects, the experimental control shown by the stability for the rates and the movement of S-922 suggest that character rates may well be an excellent experimental measure and that the tasks selected produce behavior that is readily ameniable to experimental analysis.

EXPERIMENT 3

Since the tasks used in Experiment 2 never lasted more than 2 min each, longer sessions and longer task lengths were necessary to begin exploration of the effects of these conditions on the writing rates.

Method

Subject and Apparatus

A 22-year-old male student (S-061) was promised "experimental credit" slips toward Psychology 201 extra credit on an hour-for-hour basis. He had received an incomplete in PSY 201 the previous term and was allowed to turn in credit slips as well as completing other required course work. The credit slips were due July 16, but he agreed to keep serving after that time even though all credit usable had been earned by that date. Typically, 20-30 min of conversation with the E followed each session.

Apparatus and procedures were the same as in Experiment 2, except that essays on "emotional" topics were substituted for FAs, S-016 timed himself and sessions were held in the E's office on campus, with S-016 seated at the E's desk. No

graphs or charts were made or shown to S-016 during this period. However, his data sheet was not concealed and he occasionally inspected it.

Results

Figure 9 shows the daily rates for S-016 on each task. Note that with free essays as S-016 was permitted to time himself, the length of time he spent writing appreciably increased. However, in spite of the increase, his rates remained remarkably stable, even when he wrote for as long as 18 minutes. After that session his time decreases, and then he showed a fluctuation in rate. His signature and alphabet rates seem stable. (The first four alphabet rates were written in capitals; he spontaneously changed to lower case letters at the fifth session.) Four objects were presented twice, and only one showed very close rates on the two occasions. Picture essay rates increased also after the procedure was changed so that S-016 time himself.

Discussion

The data from the first 6 free essays of S-016 indicate that character counts can be quite stable even for relatively long essays (18 min.). However, later sessions show unexplained jumps in the rates. It was planned that

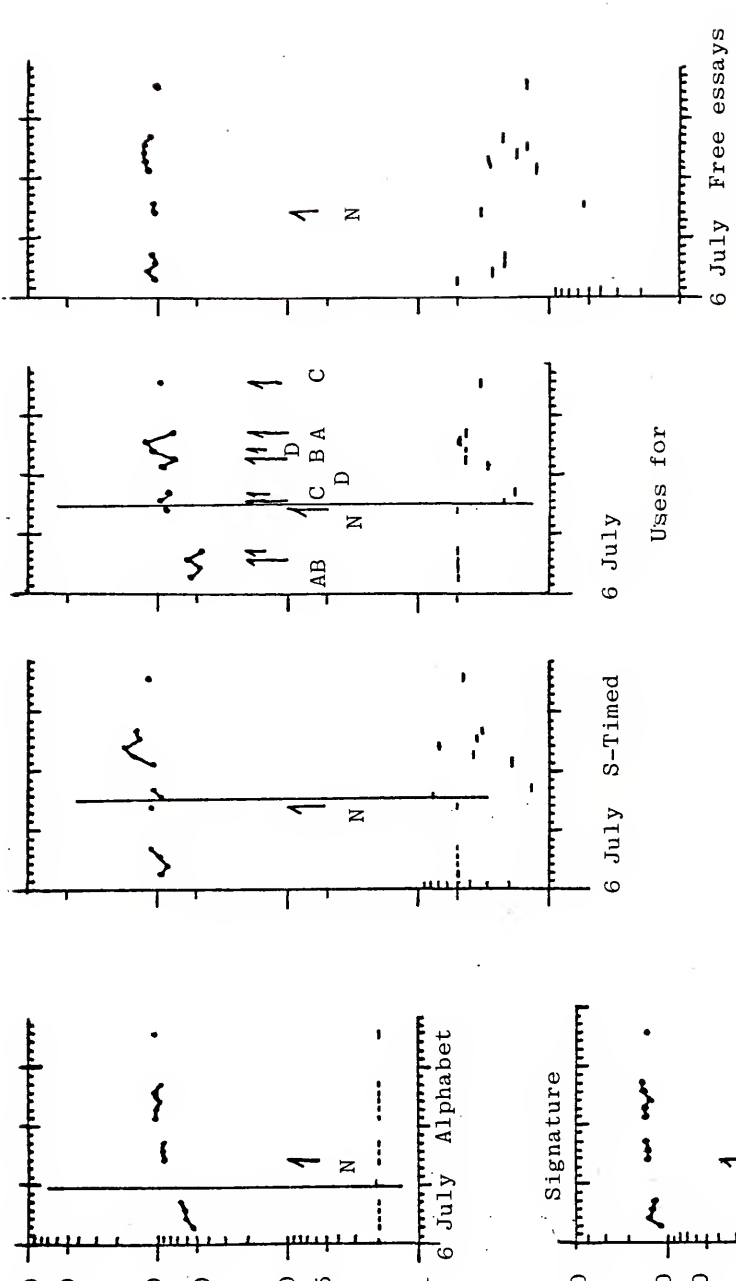


Figure 9. Charts of character emission rates for S-016 on indicated tasks. (N) indicates different locations for session. Letters indicate repeated presentation of stimuli. Successive calendar days are plotted within panels.

S-016's alphabet and picture essay performances would be charted in order to observe the effect of presentation of the chart on both a steady and a fluctuating rate. However, S-016 decided to terminate and the operation was impossible. The effects of permitting the S to time himself was, in general, to raise the rates, and to increase the time spent writing.

EXPERIMENT 4

One of the problems associated with investigation of character emission rates was the tremendous tedium of counting characters. Accordingly, a computer program was obtained to count, time and calculate rates on material typed in as text. Comparison of typed rates of character, word, and sentence production seemed appropriate, and the use of the machine permitted more efficient use of subject time, since counting was not required. In addition an attempt was made to investigate the effects of constraining the experimental task in different ways. Rates of character emission of both hand written and typed materials were collected.

Method

Subject and Apparatus

An 18-year-old female currently enrolled in PSY 201 (S-157) served under the promise of experimental credit and help with study skills. Se accumulated approximately 21

hours of experimental credit, of which 5.5 was the maximum useful. Her efforts to find a job were discussed with the E, as well as other personal issues, although study skills were not. She reported preexisting typing skills and agreed to compose essays on a typewriter. For the first 11 sessions, S-157 followed the same general procedures and used the same apparatus as S-016, except that she always used and brought the same pen to experimental sessions, and her first ten sessions were charted as were S-922's and S-380's. In addition, sessions 12 through 19 included work on the computer terminal, and some tasks were dropped. (See Figures 10 and 11.)

Two sessions (12 and 13) were held in a room assigned for student computer terminal use, containing approximately 20 assorted computer terminals and keypunches. Since S-157's session time was approximately noon, the terminal work room was full and noisy. Accordingly, arrangements were made to use another machine during the lunch hour of a terminal operator in the central administration building, since no access was permitted to the psychology department's terminal. All terminals used were IBM 2741's, which resemble Selectric typewriters. Basically, the computer timed each line typed on the terminal, and counted the characters, words, and blanks. Upon command, the count and rate of word, character, and blank production were printed out for each line, as well as the time and its reciprocal, and the overall averages for the whole performance. Sentence rates were determined by post hoc hand count.

Sequence of Operations

For her first 11 sessions, S-157 performed the same tasks as S-922 and S-380, except that at her 9th, 10th, and 11th sessions she ended the "Uses for . . . ," Picture Essay, and Free Assoc. tasks "when she was done," as did S-106. After session 9, her charts were no longer shown. After session 7 she was asked to raise her rates, and after session 10 she was told that if she could raise her alphabet rates to 175 (from approximately 156) characters per min., the alphabet task could be dropped. At session 9 an essay on an "emotional" topic was added. At session 12, all tasks except the picture essays and the essays on emotional topics were dropped, and two or three of each were done every session. For sessions 15 through 29 two PE's were done by hand, and two were done on the terminal as well as one or two essays on the terminal. Hand tasks were done first. One in each mode was to contain a question as every other sentence, and the orders were varied. At session 21, instead of questions, each sentence was to start a new line on half the PE's. At session 24, errorless performances were attempted and three texts were copied, as S-157 was going for a job interview and she wished to practice her typing skills. Before each performance during all subsequent sessions, word counts and rates done on the previous performance were announced with a request that she raise word rates, regardless of the effect on character rates.

After each performance, the rates were checked and high rates occasioned praise. For all terminal work, a clock was started when each performance began and after two to three minutes the S was told she could stop writing whenever she wished.

Drugs

After the final experimental session, S-157 revealed that she had been taking amphetamine (Desoxyn, 15 mg.) every Monday, Wednesday, and Friday throughout the experimental period and for months before it. She had selected the alternating days regimen to avoid habituation. At the same time, she also admitted to regular (daily) use of marijuana.

Mechanical Difficulties

Several problems are associated with use of the computer. First, some sessions were terminated early due to general temporary failure of the whole computing system. Secondly, overstrikes resulted in transmission of unrecognizable characters, and the computer responded by reprinting the line typed in up to the point of the overstruck character. Finally, during the return of the typing ball from the right side of the keyboard to the left, the keyboard locked, and remained locked momentarily before more characters could be typed. Timing was only of the actual time the keyboard was unlocked, but the slowness of the return was noted by subjects.

Results

Figure 10 displayed S-157's character emission rates for Free Association, "Uses for . . .," alphabet, and signature tasks for her first 11 sessions. Variability in the data for the week of July 6 for the signature and "Uses for . . ." task suggests drug activity. The effects of self-timing on both FA and "Uses for . . ." rates seems to have been to drop the rates slightly, but recovery and rise was rapid. The interruption of the experimental session by a telephone call to the E (point a) had a powerful effect on character rates. Adaptation to the experimental data tasks was especially marked in the alphabet task.

Figure 11 showed rates of behavior for the first 11 Picture Essays (PEs) and experimental PEs with declarative statements and questions alternating. Both hand and computer PEs were performed in both free and "alternating question" style, and the order of free vs. question was balanced. No great effect on rates was noted.

Figure 12 displays overall rates of word and character production for all computer "Emotional Essays" (EEs). Several days of "Uses for . . ." and copying tasks were also shown. Rates appear steady.

Character, word, and sentence rates for all PEs done on the terminals were shown on Figure 13. Notations of X with performances from 7/27 to 7/30 indicate questions

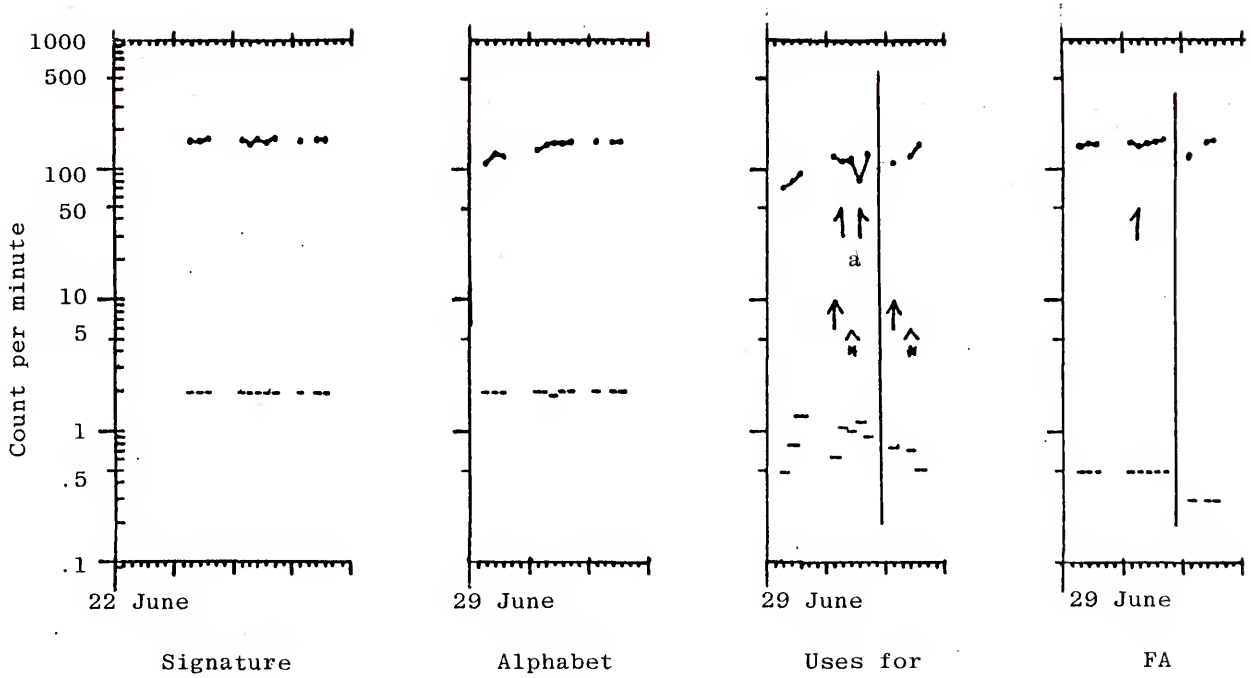


Figure 10. Charts of character emission rates for S-157. Repeated symbols with "Uses for . . ." indicated repeated presentation of same stimuli. Point "a" indicates phone call to E. Successive calendar days are plotted within task groups. The change seen in FA rates seems to be the result of an increase in writing time.

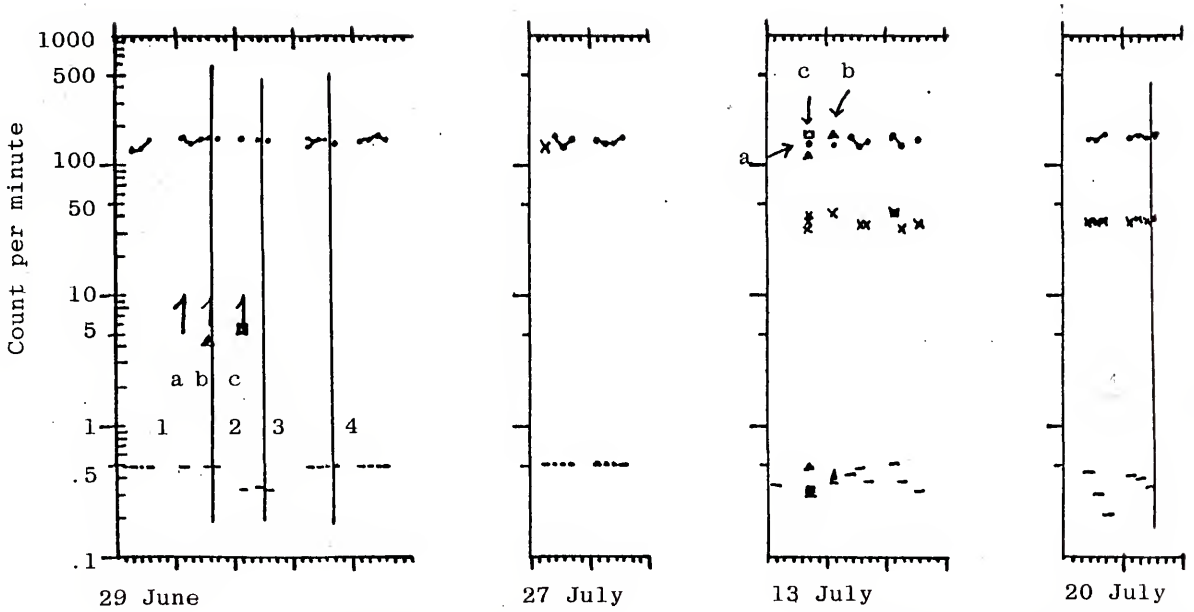


Figure 11. PE rates for S-157. All panels are of successive calendar days. Repeated symbols indicate repeated presentation of stimuli.

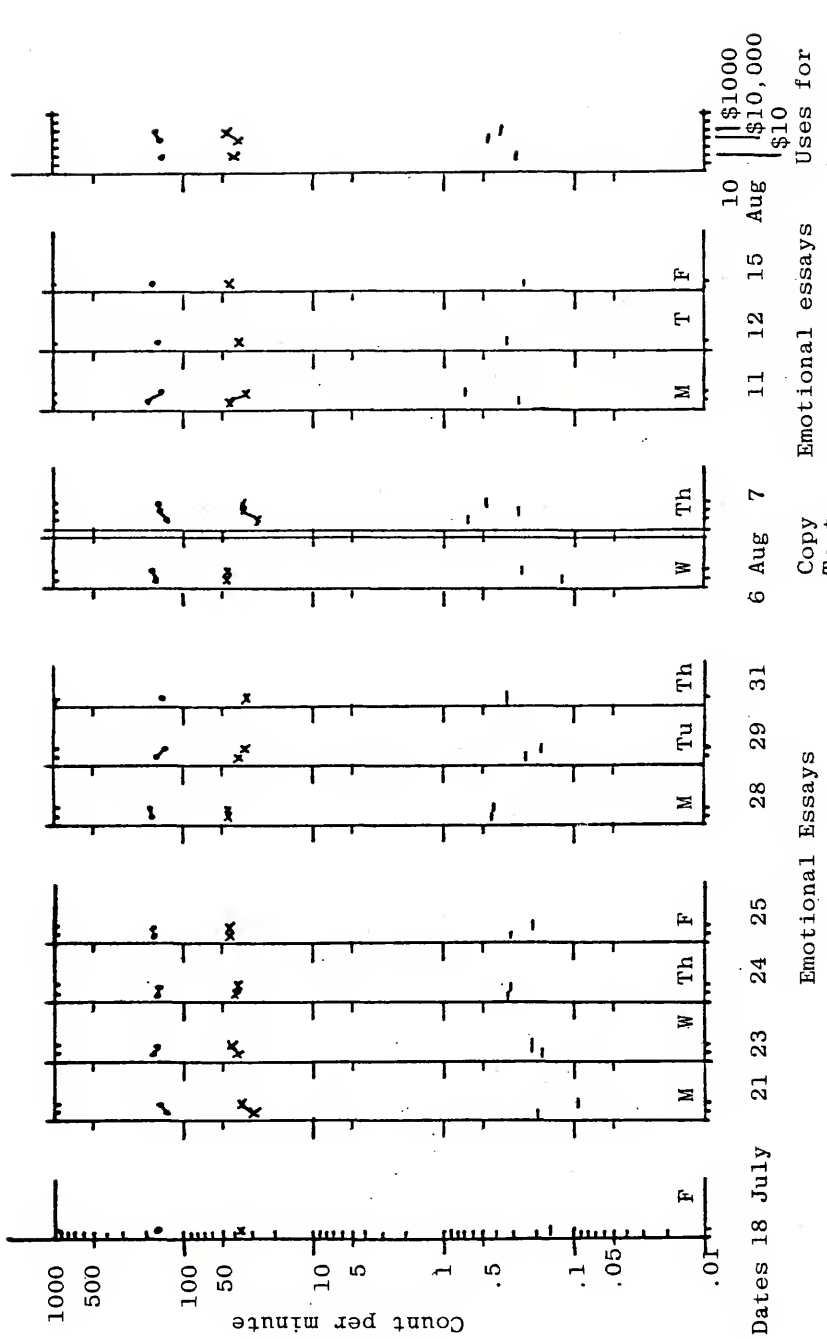


Figure 12. Successive tasks within experimental sessions for S-157. Character (•) and word (×) frequencies are indicated for the days and dates listed. "Uses for. . ." rates are plotted on successive calendar days with the amount of money presented as the simulus to write about.

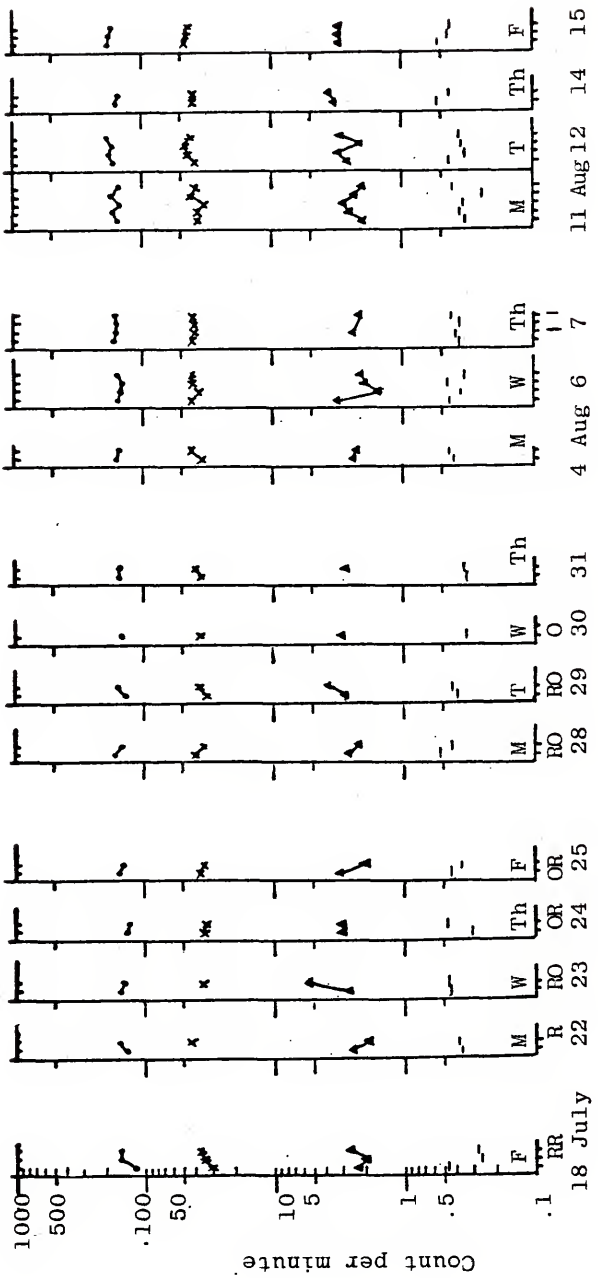


Figure 13. Character (•) word (×) and sentence (▲) emissions. Rates of S-157 working on the computer terminal are plotted for successive picture essays during experimental sessions on listed days. "R" indicates normal instructions while "O" indicates essays in which every other sentence was to be a question.

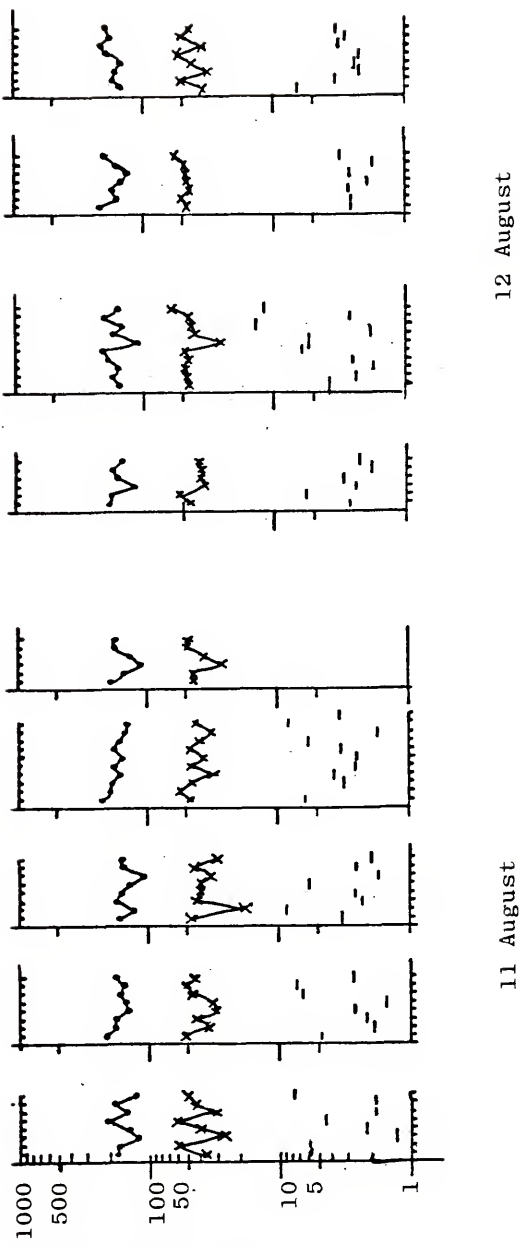


Figure 14. Charts of line by line character (•) and word (×) rates for picture essay written 8/11 and 8/12 by S-157.

alternating with declarative sentences, while R indicates no special instructions. Beginning on 8/4, a carriage return was keyed with every period, question mark, or exclamation point. Subsequently, character and word rates rose slightly. The imposition of positive statements after highger rates and statements of previous word rates on 8/11 was associated with increased variability in character and word rates, and a slight rise in rate. Line by line rates of word and character production from all PEs written on 8/11 and 8/12 were displayed on Figure 14. Note the differences in bounce and patterning of the word rates and character rates.

Discussion

Stable character rates were seen within task groupings with S-157 and an effect was noted for self-timing. Inspection of the PE records on Figure 14 revealed changes in rate trends between each level of response recorded, which may be due to the fact that while character sizes were fairly standard, word and sentence sizes varied.

The effect of the drugs taken by S-157 seemed to be minimal, as the most marked effect easily attributable to the drug was not seen across all behaviors. A larger dose may have shown greater, more easily identified effects.

EXPERIMENT 5

The general measurement tactics and procedures described previously were also applied to other subjects, thus forming a set of replications. One of the subjects serving in this phase was not a native English speaker.

Method

Subjects and Apparatus

Four subjects served in the replications of experiments 1-3. Subject S-517 was an 18-year-old male first term freshman, who served in the study in an effort to learn more about his writing. Subject S-001 was a 19-year-old fourth term female college student with a history of academic difficulty. She was serving in return for study skills help. Subjects S-99 (24 years old) and S-202 (20 years old) were both female college students serving for PSY 201 experimental credit. All subjects except S-999 were black, native English speakers; S-999 was an Iranian citizen who learned English in school. Apparatus, tasks, and procedures were the same as those used in Experiment 2, except that S-202 wrote letters to friends instead of essays, andcharts were not drawn

and shown to the subjects. On essay and letter tasks, subjects were generally permitted to time themselves.

Subject S-314 was a 21-year-old female serving for PSY 201 experimental credit. She generated stories, picture essays, and letters using a computer terminal and the same program as was used by S-157.

Results

Figures 15, 16, 17, 18, and 19 display the rates of character permission per minute for each task performed by each subject. The data resemble charts previously shown for other subjects, except that attendance was generally more sporadic and fewer sessions were run. Note that the first data point was quite representative of frequencies of behavior for S-001, and was moderately representative for S-517, while S-202's first letter rate was not a good indicator. For three out of the five tasks, S-999's first rate was also not a good predictor. The data for S-314 are similarly more sparse than those shown for S-157, and S-314's rates are lower.

Discussion

In general, these data conformed to the data generated by the other subjects. First session measurement of rates of behavior was not seen to yield a reliable baseline.

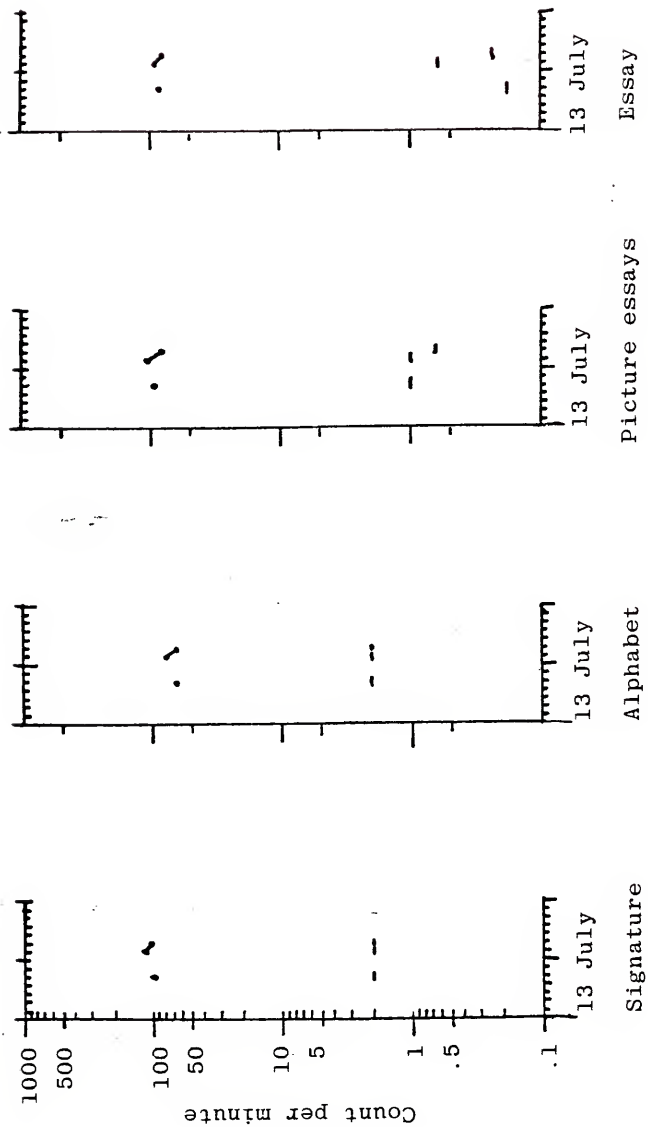


Figure 15. Charts of character emission rates for S-001 on tasks listed. Successive calendar days are indicated for each panel.

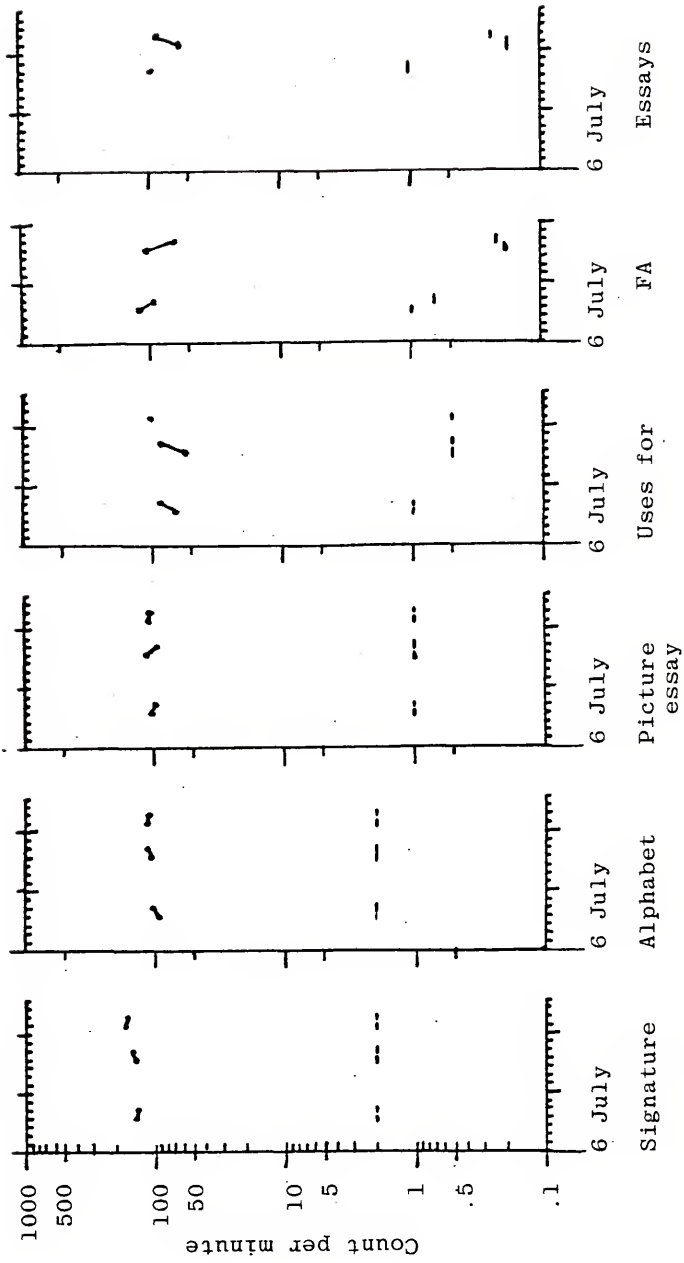


Figure 16. Charts of character emission rates for S-517 on tasks listed. Successive calendar days are indicated for each panel.

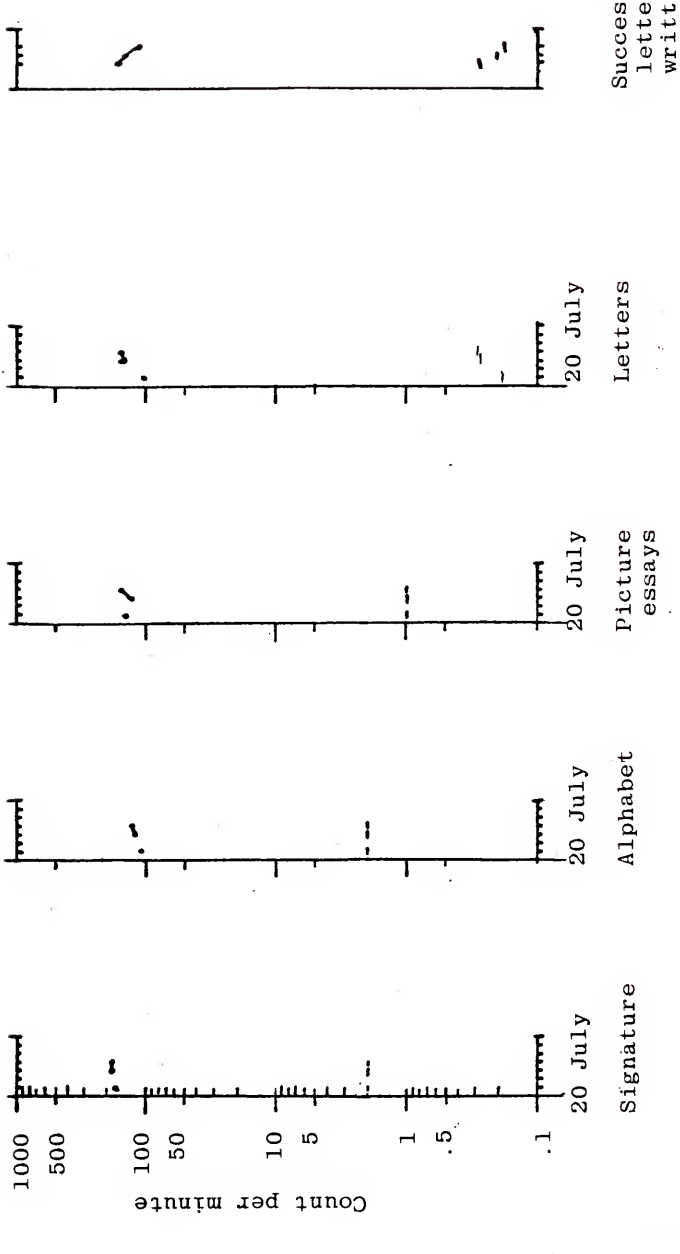


Figure 17. Charts of character emission rates for S-202 on tasks listed. Successive calendar days are indicated for each panel, except the last one, in which three performances were emitted in the same day.

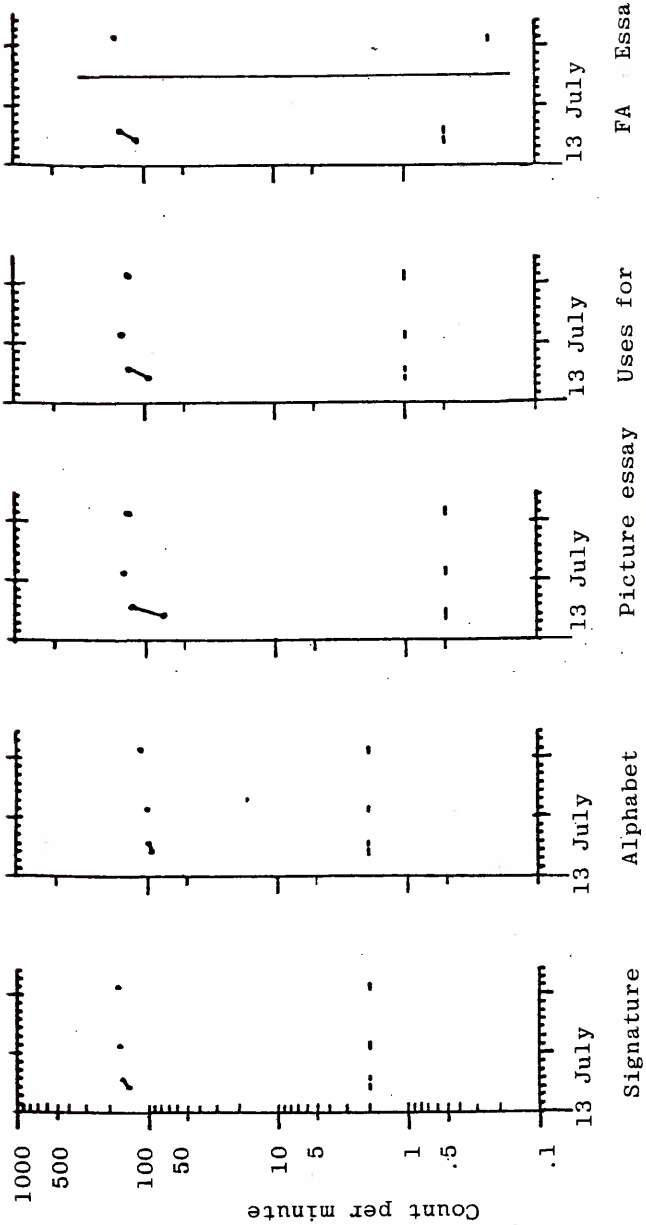


Figure 18. Charts of character emission rates for S-999 on tasks listed. Successive calendar days are indicated.

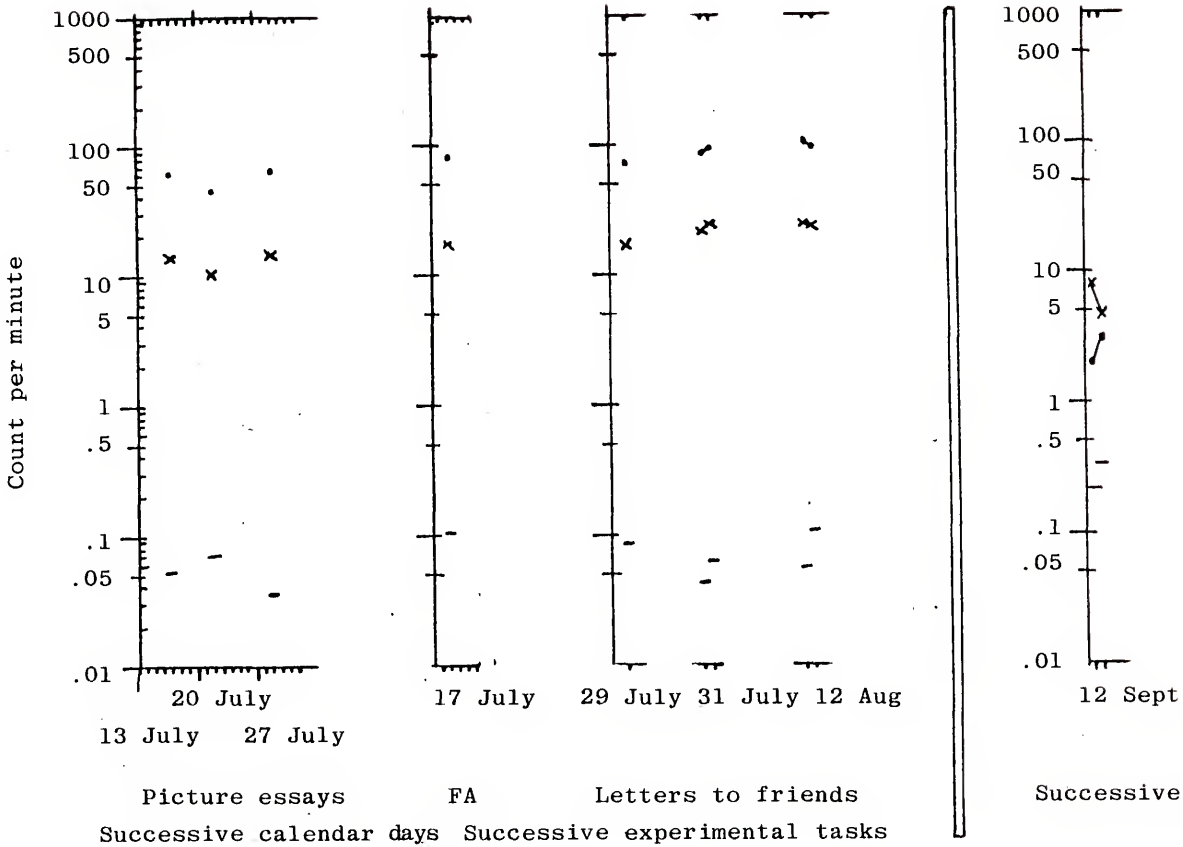


Figure 19. A. Character (—) and word (✕) emission rates on indicated tasks by S-314 using computer.

B. Correct (•) and incorrect (✕) character emission rates for S-922 on successive trials.

EXPERIMENT 6

Experiments 1-5 dealt with the frequency of emission of character and words to the relative exclusion of investigation of the topography of the responses. Experiment 6 was designed to demonstrate control of the topography of characters emitted by the consequences of emission of selected characters.

Method

Subject and Apparatus

A subject who had participated in an earlier phase of the investigation (S-922) was asked to serve again. One experimental session was held under conditions approximating those of Exp. 2, except that a yellow lined 8 1/2 x 11" legal tablet was used to record the responses, and timing was done by reference to a Westclox electric clock.

Procedure

The subject was instructed to write characters "to guess a simple word," and the E would respond "no" after incorrect characters and "yes" after correct ones, and circle

the correct ones. The same word, "CARDBOARD," was used for both trials.

Topography Measurement

The "correct" topography was defined as the next letter in the stimulus word, while an "incorrect" topography was defined as any other character. Hence, a direct measure of topography was possible by simply counting the correct and incorrect letters.

Preliminary Sessions

One preliminary session was held with S-922, in which the phrase "white dogs are quieter" was selected. The following difficulties were found: after the first two words, S-922 adopted the same procedure (writing the alphabet) as a system for locating the correct response, and she announced a desire to stop the session as the task was boring. Hence, CARDBOARD was chosen for the next task, as the first letters appear early in the alphabet, as does the B in the last part of the word. The "B" was important because few cues exist to signal the next letter after the first syllable.

Experimental Error

After the first trial, the S pointed out that "CARDBOARD" was a compound word, not a simple one. The instructions

were amended for the second trial by the substitution of "easy" for "simple," and the S was encouraged to try again.

Results

Figure 19 part B displays the correct and incorrect character emission rates for trials 1 and 2. Note the control of the topography of the response by the consequation, as the incorrect characters decelerate and the correct characters accelerate. The change in topography of the response went from 9 of 47 responses correct to 9 of 23, and the rates show an even more dramatic effect, from 2.0 per minute correct and 8 per minute incorrect to 3.18 per minute and only 4.87 per minute incorrect.

Discussion

The change in topography of response under the experimental conditions supports the notion that the consequences of emission of a given character (and hence a given word) control the topography of emission as well as the frequency.

GENERAL DISCUSSION

Since issues are raised that fall in several diverse categories, the discussion is arranged topically.

Unit of Response

The findings with respect to the unit of measurement appropriate to compositional behavior may seem unclear. On a FA task in Exp. 1, S-803 demonstrated a clear rise in word emission rates while simultaneously lowering her character emission rates by shortening her average word length. However, S-157, when writing texts, showed a general parallel movement of word and character frequencies, as did S-314.

More research is needed to clarify the differences between these two rates, but one possible explanation for the lack of separation with S-157 may be the textual constraints imposed by the requirements of the essay task. In Exp. 1, S-803 was under no contingency to produce words with any specific denotation, but S-157 was required to emit connected discourse, which may have prevented her from shortening her words as drastically as did S-803. Thus, until more research is undertaken, it would seem most prudent to record both frequencies, but, in situations in which lack

of resources makes that difficult, word frequencies may be easiest to measure and explore.

Machine Writing

The ease of measurement of character and word emission rates with the aid of the high speed computer increases experimental efficiency tremendously. A simpler way of obtaining similar measures may be to instruct subjects to type on a standard electric (or manual) typewriter and to type all the way to a specified right margin and no further before operating the carriage return, thus typing lines of a specific fixed length. An external timer and a count of the words or blanks in each line would provide the basis for word rates, and subtracting the number of blanks from the line length would give the information for the character rate. Thus, the advantages of mechanical recording may be available without the expenses and inconvenience associated with computer use.

Environmental Control

Writing, like other behaviors, has two basic characteristics: some frequency of occurrence in time and some topography or form. Several examples of control of frequency of character and word rates have been prescribed. An announcement of a contingency was sufficient to dramatically

move S-922's character emission rates in all measured behaviors. In general, announcement of the task controlled differing rates for most subjects. A more subtle example is shown in the data from S-803 (Figure 4): the part of speech (adjective or verb) to be generated to match one of the two lists of nouns had a dramatic effect on the frequency, and indeed the noun lists themselves also differentially controlled the rates.

Generally, control of the topography of the response was done simply by announcement. No subject made an extended topographically inappropriate response; all produced written materials that met the specification of the experimental situation. For example, no subject responded with an alphabet to the signature task, or vice versa. Overall, specification of the acceptable response was sufficient to produce that response, and a change in specification produced an immediate change in topography of response.

An effect of the topography on the response rate may be seen in the alphabet rates of S-016. One topography (all capital letters) was emitted at a response rate different from the other (small letter) rate. Another example may be seen in the data for S-803 cited above. Finally, Exp. 6 unequivocally demonstrated control over the topography of a written response by the consequences of that response.

Pedagogy

Perhaps the greatest value of the present work lays in its relationship to instruction in written composition. The orderliness seen in rates of character and word emission under experimental conditions justify the diversion of scarce classroom time and resources to programs of daily measurement of word emission rates during composition classes by teachers and experimental psychologists.

Zoellner (1969) requested a measurement system for classroom use that would allow teachers to display increments of improvement in writing. The present work provides a basis for attack of the problem of measuring improvement. Since writing frequencies seem to be stable, changes in the quality of a student's writing may be shown by marking all of the words in a composition that are inappropriate, and plotting the rates of appropriate and inappropriate words written per minute by the students. Clearly, any improvement will show up as a relative drop in the frequency of incorrect words emitted or a rise in the frequency correct. Specific types of errors may be handled in a similar fashion. One type of choppiness, for example, may be seen as a frequency of emission of terminal marks (.?!) that is too high relative to the frequency of words emitted. After initial measurement, any

change in sentence length must show up as a change in the frequency of terminal marks relative to word frequency. Hence, one may assess the effect of an announcement or instruction on choppiness by examining the frequency of terminal marks relative to the word frequency. Thus, precise measurement of the change in student performance due to instruction is possible, and with such measurement the efficiency and effectiveness of different instructional strategies may be assessed. Accountability in terms of cost for a given unit of student improvement is also possible.

Specific pedagogical tactics remain to be explored, but some implications may be drawn from the present study. First, the results seen with S-016 suggest that self-timing by students may be a useful tactic for increasing the time spent writing. Secondly, the data with respect to measurement of word versus character emission frequencies equivocally suggest that word emission rates may be sufficiently stable, but further investigation of this point seems indicated. Thirdly, both the frequency of emission and the topography of the characters emitted can be controlled by manipulation of the environment, so that teachers can arrange conditions under which students will write well. Thus, the extension of the findings of the experimental analysis of behavior to written composition as aids to teachers and students may be slightly closer.

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BIOGRAPHICAL SKETCH

Charles T. Merbitz was born on March 30, 1946, in Chicago, Illinois. He graduated from a private high school in Chicago in 1964.

In 1970, he married Gloria Golec and also received a B. S. from the University of Illinois at Chicago Circle.

In 1971, after a year of work in business, Mr. Merbitz began graduate studies at the University of Florida in Gainesville. He received his M. A. in Psychology in 1973. While at the University of Florida, Mr. Merbitz was employed as a research assistant in an animal operant behavior lab; served as Academic Advisor in University College to Minority Students (EEOP/SSS program): was Tutorial Coordinator for the Personalized Learning Center and taught in the Department of Behavioral Studies.

Mr. Merbitz presently resides in Lake Wales, Florida, with his wife, and is employed as a school psychologist by the Winter Haven Hospital.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

H. S. Pennypacker, Chairman
Professor of Psychology

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

M. K. Goldstein
Asst. Professor of Psychology

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

M. E. Meyer
Professor, Psychology

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

J. M. Newell
Professor of Education

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

F. S. Sieka, Ph. D.

This dissertation was submitted to the Graduate Faculty of the Department of Psychology in the College of Arts and Sciences and to the Graduate Council, and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

December, 1975

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